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AVIATION AND AERONAUTICAL ENGINEERING



The Italian 37-Ton Airship Roma in Full Flight During Her Trials

VOLUME VIII

Number 9

SPECIAL FEATURES

NEW GLENN L. MARTIN TORPEDO PLANE
BAKELITE MICARTA PROPELLERS
THE ITALIAN SEMIRIGID AIRSHIP ROMA
THE LOUGHEAD SPORT BIPLANE

Three
Dollars
a Year

PUBLISHED SEMI-MONTHLY

BY
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HIGHLAND, N. Y.

HARTFORD BUILDING, UNION SQUARE
22 EAST SEVENTEENTH STREET, NEW YORK

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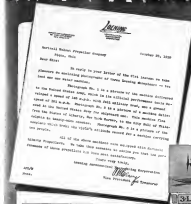
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Vol. VIII

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No. 6

THE rules and regulations for the airplane and airplane competition the British Air Ministry will hold in the coming summer have just appeared. Certain technical requirements are of interest.

In the general number of requirements, it is particularly interesting to see that the term, *indicator* is deleted. This instrument has evidently passed into general use.

One paragraph reads: "No landing apparatus may be used which, in the opinion of the judges' committee, would be liable to cause undue damage to an aerodrome." A class, attached to the machine, is used on certain German machines, will not be allowed, but the ordinary half type on a half shaft will be allowed. There is a tendency amongst American designers to design tail skids approaching steel frame, and the Air Ministry evidently attempts to check this tendency.

For twin engine machines, the rules call for a getaway with half load, with one engine completely shut off. The British are hesitant in asking for half a load. Requirements in this country for twin engine machines have been for a getaway with full load.

Another requirement calls for flying at cruising speed for 5 minutes, without the use of any controls or stabilizing devices. The committee getting up this rule would certainly not outside such a requirement unless they knew that stability of this character is quite possible of achievement. It may be said that this is a requirement which should be imposed on all commercial machines.

Machines are expected to stand unaided in a wind of not less than 15 m.p.h. It is not at first evident that anything can be provided for in the design of a machine to meet this requirement. Perhaps it would help if the body were very low, and the wing at its own propulsive proportions.

Carefully graded tests are allowed for various features, such as speed, landing, climb, response in flight, economy, and ground clearance have been developed.

The rules as a whole are satisfactory, and a competition of this character is the most satisfactory from a design point of view that any speed test or even a cross country test.

The Italian Airship Roma

The new Italian airship *Roma*, a description of which appears with various illustrations in the present issue, should check more than passing interest on several counts.

The fact that the *Roma* is by far the largest aerostat ever constructed—it is being about twice that of its largest forerunner—would alone be worth notice. It was believed assumed that the largest "usable" aerostat was in the neighborhood of half a million cubic feet capacity which was due mostly to the belief that beyond that size the risk of disposable lift to gross lift would become too unbecomingly for practical purposes. The *Roma* sports this assumption by having an efficiency ratio of over 11 per cent. This is a whole lot better than that of the British *R34*, for which ship

the efficiency ratio is only about 45 per cent, although its size is some 40 per cent larger than that of the Italian aerostat. It may be argued that the *R34* is not by any means the last word in rigid construction, for the German *Friedrich*, only one third the size of the former, has none the less an efficiency ratio of 45 per cent.

This argument is however rather misleading, for it should be noted that the *Roma* is by far the most heavily armed aerostat in existence, its horsepower aggregating 2,400, which was that of the Zeppelin *L-17*, a ship twice the size of the Italian vessel. That with such a powerful propelling apparatus the desired speed is to reach 40 m.p.h. is not to be wondered at, but the perfect efficiency of the hull should be a good contributor to this performance. And here it may be remarked that the *Roma* rate of the hull of the *Roma* is 5 to 1, that is, much smaller than that of the best aerostat streamliner in use. For the *Friedrich*, which is "fatter" than any previous rigid, the *Roma* rate is 6.5. Italian aerostat constructors have always maintained that all contemporary aerostats but their own had too large a fineness ratio and attributed the high speed/horsepower ratio of their vessels to this very means. It will be interesting to watch whether the tests of the *Roma* will again confirm their pretensions.

Another interesting feature of the *Roma* is the use of the so-called *Fiedrich* rudd, that is, a longitudinal lobe on top of the nacelle formed by support struts in the manner of the *Auton-Deux*, from which suspension cables run to the hull girder. As the latter in all the well known aerostats, the *Roma* may be regarded as a compromise between the previous military type of Italy and the experimental *Friedrich*, and probably embodying the best features of both.

In view of the many novel features above mentioned the tests of the *Roma* will with keen interest by all concerned with the development of lighter than air craft.

Resistance of Steamship Bodies

Some interesting comparisons are made by a German writer on the resistance of various types of bodies, which emphasize what it is possible to do with stream lining. Thus a plate 37 in. thick square has a resistance equal to that of a stream line body of 12 inches length and 2 inches diameter. It has a resistance equal to 4 rounded wheels, 65 centimeters by 7.5 centimeters in dimensions, and 8 rounded wheels of the same size. Everyone understands the advantages of stream lining, but when the actual comparative figures are set down in this fashion, the results are truly startling.

Herring the Passenger Phase

On an English motorcar, a wind beating indicator has been installed in the passenger cabin. The best is obtained by raising the wind air round an exhaust extension pipe.

The idea is quite simple and it said to be absolutely free from danger of fire. On a cold winter day, at high speed, absolutely comfort is thus insured for the occupants.

Bakelite Micarta Propellers

During the past few years there has been developed two various civilized uses and also for various parts of automobiles a composition material called "Bakelite" after the inventor, the Bakelite has the same natural properties that experiments are now being made with airplane propellers built of it. From the results thus far obtained, it is evident that these propellers have several advantages over those constructed of wood.

Bakelite is a hard and, particularly in its composition material derived from the combination of carbolic acid, cresol, or phenol, and formaldehyde. These when combined in the proper manner form a resin which in its present state may be then added or third, but in either case is essentially a soft resin which affected by heat and solvents. It subjected to heat and heat and pressure for a time, then, the resin is solidified and is then a hard solid not affected by ordinary solvents or temperatures that ordinary wood

Problems of Wood Propellers

Probably the principal objection to the use of wood for airplane propellers is warping, and the consequent changing of shape, due to unequal absorption of moisture in the different laminations or to inequalities in the rate of drying. It is generally impossible in the commercial manufacture of wood propellers to get all of the laminations of exactly the same moisture content. In addition to the variations in the wood of natural content, the various laminations are much of one, of the same density. It follows, therefore, that the rate of moisture absorption of the different laminations will vary more directly with residual warpage and changing of shape of the propeller as a whole. This is particularly true in civil aviation in respect of the wide differences in temperature and humidity between the cold, inland air of the sea or in levelled balloons.

Various coatings, no matter how carefully applied, do not

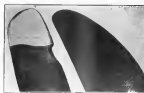


FIG. 2. Left—WOODEN PROPPELLER, RIGHT—MICARTA PROPPELLER.

changes in shape, forces and in the driving torque without damage. The answer must be found and taught to resist the adverse action of air and steam concentrated while flying and periods of heat and cold when taking off or landing. It is natural that the solution of these problems of the propeller will have a tendency to better or run out of track. Finally the product must have permanence of shape. The elastic resin must remain constant and the blades maintain their alignment, to secure a good propeller performance.

Bakelite micarta satisfies, more or less completely, all of these requirements. The following comparisons may be made between bakelite and wooden propellers.

Strength.—Bakelite has greater mechanical strength than wood, making possible the use of thinner blade sections with increased efficiency. The modulus of rupture is from 37,000 to 20,000 lb. per sq. in. as against from 5,000 to 20,000 lb. per sq. in.

Corrosion.—Micarta propellers will not crack or split. The material is suitable for irregular or curved blades and blade joints can be used which would be impossible with wood.

Flexibility.—Figure 2 illustrates the relative warping qualities of woods and wood. Both propellers were run in a water spray at 1,000 r.p.m., the wooden one for a few minutes only and the micarta for one-half hour. Practically the only damage done to the micarta propeller was the removal of the little part of the leading edge while the wooden propeller the material was worn away considerably, where as protected by metal tips.

Permanence of Shape.—Micarta propellers are not affected by atmospheric changes and will hold their shape indefinitely. No special precautions are necessary in handling, storing and shipping.

Uniformity of Material.—One difficulty in the manufacture of wooden propellers is the warping of moisture material. Existing methods of curing and seasoning the wood are necessary to secure adequate strength and satisfactory performance. Micarta propellers are manufactured in such a way that uniform characteristics are assured.

Weight.—Micarta propellers have about the same weight as the use of the better grades of wood. This is possible because of the great strength of the material, which makes possible the use of a smaller hub portion and thus a lighter neck leading to the motor. This micarta is possible to replace the heavy flanges and bolts used with loadings for wooden propellers by four light keys driving into the motor. It is even possible to eliminate the metal hub entirely if the motor shaft can be modified to prevent the use of more keys.

With micarta propellers it is possible to secure increased thrust characteristics by increasing total disc area without additional rigidity is desired. This will be explained more fully later.

One great advantage of micarta over wood is that it does not split and it is hard enough to stand the stresses of service without being fitted with metal shrouding. This is of considerable importance in propellers designed for use with high powered engines.

Working Characteristics

In working this material, good results have been obtained with a flat tool and a cutting speed of a little over 1,000 ft. per min. The cutting tool should have a slight curve. In general wooden material cuts very much like hard wood. In making perpendicular to the laminations, as for instance, making up gear teeth, keyways in propeller hubs, etc., it is advisable to back up the material with a hard wood plank to prevent splitting of the fibers where the cutter comes through.

Handing or other working of micarta forms is not always necessary, however, as it is quite possible to form the material to the exact shape desired within quite close limits, provided the micarta are properly made for this work and the manufacturing process strictly carried out.

It is possible to mount a micarta propeller directly on the propeller shaft, but doing this with the metal hub. This not only makes the work somewhat, but increases the number of parts to be made and fitted, which is an obvious disadvantage in having not a large number of micarta. Perhaps one of the strongest points in favor of micarta as a propeller material is the fact the propellers can be built much more quickly in this method than by making wood propellers in the usual way. Moreover, all of the micarta propellers made from the same mold will be exact duplicates of one another and will be permanently finished when they leave the molds, requiring only balancing and slight tuning up before they can be put into service. Thus a production standpoint, therefore, micarta propellers are much to be preferred to wood propellers made in the usual way, provided that the five types are equal in other respects.

500-Horsepower Push Features

The micarta propeller only needs to be in process one day, but it is, of course, necessary to provide considerable time for building molds before quantity production can be begun. This is one of the disadvantages of micarta construction, as it is necessary in propeller work to allow from one to two

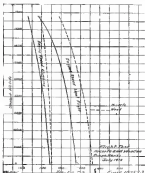


FIG. 3. GRAPH OF FLIGHT TESTS OF WOODEN AND MICARTA PROPPELLERS.



FIG. 1. MICARTA PROPPELLER FOR LOCKHEED TRIGLER 480-H.P. ENGINE. THIS PROPPELLER WITHSTOOD OVER 1,500-H.P.

disadvantage a gain at two. When in the condition bakelite is not suitable for use in such work. It will not burn at all readily, but will char and burn slowly at temperatures in the region of 300 to 400 deg. Cent.

Bakelite, when properly formed and hardened under the influence of heat and pressure, is much harder, stronger, and more glass-like than practically any other organic material.

Bakelite Manufacturing Methods

There are two commercial methods of refining bakelite. One is to combine it, between heating and forming, with a filler, such as for instance wood flour or a very finely pulverized and prepared wood fiber, and mold the composition to the desired shape in semi-rigid, drilled steel molds. The other process consists of building up plates or tubes from sheets of material which have been treated with bakelite in the form of a veneer. Automobile section distributors have good examples of the former method, and airplane wheels and similar forms are often made by the latter process.

Recently bakelite has been used in combination with strong kiesel paper or with cotton, silk, or wooden materials in the making of various molded forms. The usual method of manufacturing is to run the paper or cloth and so on over a roller heated to the proper temperature, after coating the base material with a thin coating of bakelite. As the material is wound on to the roller it is compressed by the bakelite. Tubes and various hollow sections are made in this way. Driveline hollow shapes are formed by passing the roller or material which the composition is placed on and pressing it to the desired shape while in this condition.

By another method flat sheets of cloth or paper are treated with bakelite and pressed to form solid blocks of various shapes. The material formed by coating a cloth or paper base with bakelite impregnated and pressing a number of these prepared sheets into solid blocks is known as the trade name of Micarta. This is marketed by the Wilmington Better and Manufacturing Co.

propeller wood propellers from absorbing or giving up a certain amount of moisture with changes in atmospheric conditions. This has been proven in numerous tests.

Other methods have been tried of protecting the wood from water absorption, such as coating the whole propeller with metal-hell applied over a lining coat in the same manner that gold-leaf signs are applied to store windows. Electroplating and the application of hard rubber coatings has also been tried, but none of these processes has proven satisfactory. All of these methods add considerable weight to the propeller, and, moreover, are subject to chipping or breaking under the pressure of slight abrasion, with the result that moisture gets in at one point and soon disintegrates the whole propeller coating.

Metal Propellers

Various experiments have been conducted, both in the United States and different European countries with metal propellers, but all these tests have proven uniformly unsatisfactory. The most serious fault in a metal propeller is the danger of vibration effect frequently spoken of as crystal action. Weight and rigidity are other grave defects. In order to reduce weight, hollow propellers have been tried, but these are responsible for manufacturing reasons. Attempts also have been made to produce metal propellers of thinner sections than wooden types, but these were not as strong as they should be, and moreover, it was found that reducing the thickness of the section by half resulted in a gain of only 5 per cent in efficiency.

It is considered probable that metal propellers may prove superior to wood at speeds between 2,000 and 3,000 r.p.m. but it will probably be some considerable time before these speeds are reached in practice, if ever.

Requirements of Satisfactory Propeller Material

A successful propeller material must possess the following characteristics. It must have adequate strength to resist large centrifugal and thrust forces and to withstand sudden

Book Reviews

Difference in setting of stabilizing planes given	Difference in load at various stabilizing planes possible				
	Stabilizing	ail.	ail.	ail.	ail.
Angle tail plane up at year rate	up to 10°	up to 10°	up to 10°	up to 10°	up to 10°
1.0	1.0	1.0	1.0	1.0	1.0
1.5	1.5	1.5	1.5	1.5	1.5
2.0	2.0	2.0	2.0	2.0	2.0
2.5	2.5	2.5	2.5	2.5	2.5
3.0	3.0	3.0	3.0	3.0	3.0
3.5	3.5	3.5	3.5	3.5	3.5
4.0	4.0	4.0	4.0	4.0	4.0
4.5	4.5	4.5	4.5	4.5	4.5
5.0	5.0	5.0	5.0	5.0	5.0
5.5	5.5	5.5	5.5	5.5	5.5
6.0	6.0	6.0	6.0	6.0	6.0
6.5	6.5	6.5	6.5	6.5	6.5
7.0	7.0	7.0	7.0	7.0	7.0
7.5	7.5	7.5	7.5	7.5	7.5
8.0	8.0	8.0	8.0	8.0	8.0
8.5	8.5	8.5	8.5	8.5	8.5
9.0	9.0	9.0	9.0	9.0	9.0
9.5	9.5	9.5	9.5	9.5	9.5
10.0	10.0	10.0	10.0	10.0	10.0

It will be noted that it takes a very small change in the setting of the stabilizing planes to make a big change in balance. In fact, possibly, the change in balance is much larger than the change in setting is necessary to make the corresponding change while gliding at slow speed. The 2N-601, as usually supplied in the field, is fairly well balanced while gliding under full power—slightly nose heavy at intermediate high speed, as on a flat glide, and quite nose heavy on a steep glide. When this condition is indicated, the machine is steadily unstable nose upwards in longitudinal V will help more than a change of wing.

For instance, suppose that perfect balance on a nose heavy machine is obtained with various weights for various respective conditions, as follows:

Change—balanced without weight.
Flat glide—15 lb. required at tail.
Horizontal glide—20 lb. required at tail.
Glide at 110 m.p.h.—45 lb. required at tail.
Then, if we reverse the longitudinal V by putting a block 110 inch thick under the rear spar, we now have (referring to table 1) a machine balanced as follows:
Change—33 lb. left required on stabilizing plane (tail hinge).

Change (100 m.p.h.)—Perfect balance.
Horizontal glide—Perfect balance.
Dive (130 m.p.h.)—22.5 lb. on tail (nose heavy).
We have noticed the difference between the two extreme conditions by 65—(122.5 - 57.5) 345 lb.

A method suggested for correcting longitudinal balance of 2N-601 airplanes is as follows:

Suppose the machine is now nose heavy. Or, otherwise, attach different weights to the trailing edge of the longitudinal portion of the center of the stabilizing plane, and place good pieces of fly the machine in straight away flying. Changing weights, and the machine will fly the proper weight for longitudinal balance for all-round flying conditions has been obtained.

Example—Suppose that it is found that the application of 45 lb. at the rear edge of the stabilizing plane gives the machine in perfect balance for nose conditions. Fly reference to the above table, it appears that the rear edge of the stabilizing plane should be raised by about 120 deg. or about 0.90 m., assuming that the fixed point is at the two C bolts near the trailing edge.

To accomplish this, it will require not only changing the vertical fin and rudder, but also the angle of the trailing edge, but now wires and changed tail bracing will be required where they attach to the front spar of the stabilizing plane (about 12 in. or more of the trailing edge).

It is not supposed that the construction of the stabilizing plane will bring the 2N-601 into perfect balance under all conditions. In the above table, no account has been taken of the relative weight of the two of the three, but of the relation of airplanes in stabilizing plane. However, if nose heaviness is completely cured under given, it will always be naturally reduced for a glide, for the same air speed.

In most the machine or as tail heavy by adjusting the stabilizing plane within the limits indicated herein, it will then be necessary to change the structure of the machine.

For the particular machine a change of stagger of 1 in. on the upper plane, provided the angle of incidence is not changed, should correct for about 7 lb. at the center of the stabilizing plane. In other words, a change of stagger of the upper wing of 1 in. is approximately equivalent to a change of the setting of the stabilizing plane of 0.115 deg. or 0.13 in.

—See Bureau Information Circular.

AIRCRAFT CHARACTERISTICS. By Prof. Frederick E. Hall. (D. Van Nostrand Co. 125 pp.)

Written by a physicist and an experienced teacher, this work is an excellent contribution to the elementary study of aerodynamics.

Simple as the treatment is, it is correct. The student reading this book will not have to acquire anything when passed on to a more advanced study. Perhaps, these remarks do not apply entirely to the stability portions of the book, where the treatment is not quite so rigid.

The glossary of the National Advisory Committee for Aeronautics is expanded for the benefit of those not familiar with the standard Anglo-American aeronautical terminology. This is an excellent idea and might be generalized by authors of aeronautical textbooks. For it is well known that many of the same duplicate terms which only serve to confuse the reader.

THE AIRCRAFT PHYSICS, 1918-1920. By R. B. Bessie Matthews. Seventh Edition, Revised and Enlarged. (Crosby Lockwood & Son, London.)

The author states in this preface that a very considerable portion of the book has been rewritten, in part increased, and that it has been carefully brought up to date. Nevertheless, there is much to be learned from this book, and it is a most excellent introduction to the study of aerodynamics. The book is divided into two parts. The first part is devoted to the study of the aerodynamics of the aircraft, and the second part is devoted to the study of the aerodynamics of the engine. The book is written in a clear and concise style, and it is a most excellent introduction to the study of aerodynamics. The book is divided into two parts. The first part is devoted to the study of the aerodynamics of the aircraft, and the second part is devoted to the study of the aerodynamics of the engine. The book is written in a clear and concise style, and it is a most excellent introduction to the study of aerodynamics.

While there is considerable improvement over previous editions, the pocketbook is still far from being satisfactory. Dr. Bessie Matthews' book is a most excellent introduction to the study of aerodynamics. The book is divided into two parts. The first part is devoted to the study of the aerodynamics of the aircraft, and the second part is devoted to the study of the aerodynamics of the engine. The book is written in a clear and concise style, and it is a most excellent introduction to the study of aerodynamics.

This book may well be termed An Automobile Encyclopedia, as the subject is very fully covered. It is particularly useful for the mechanic and the owner of a car. The book is divided into two parts. The first part is devoted to the study of the mechanics of the car, and the second part is devoted to the study of the mechanics of the engine. The book is written in a clear and concise style, and it is a most excellent introduction to the study of mechanics. The book is divided into two parts. The first part is devoted to the study of the mechanics of the car, and the second part is devoted to the study of the mechanics of the engine. The book is written in a clear and concise style, and it is a most excellent introduction to the study of mechanics.

THE AIRCRAFT PHYSICS, 1918-1920. By R. B. Bessie Matthews. Seventh Edition, Revised and Enlarged. (Crosby Lockwood & Son, London.)

This is a four language dictionary, Italian, French, English and German. It has a very useful system of index and the body of the work is divided into suitable parts, such as types of airplanes, atmospheric conditions, flight, descent, flight, body, tank, etc., so that the reader is readily able to find precisely what he was looking for. The book seems to be very suitable as regards English and French terms, but some of the English words given, such as "balloon" and "aerobics plane" do not get an complete confidence.

Despite some flaws the book should prove helpful in the reading of foreign aeronautical publications.

New Glenn L. Martin Navy Torpedo Plane



FIG. 1. THREE-QUARTER FRONT VIEW OF THE NEW GLENN L. MARTIN TORPEDO PLANE

The Glenn L. Martin Co. has just completed another new type of torpedo plane of the United States Navy. The plane was given its final test on May 6, 1932, at McCook Field, Dayton, Ohio. Both Army and Navy officials witnessed the test and saw the performance of the new torpedo plane on several occasions.

The new Glenn L. Martin Navy Torpedo Plane has a wing area of 11,510 sq. ft., which includes a useful load of 1,000 lb. In addition to the crew of three men, pilot, observer, and gunner, the plane carries a 3,000 lb. torpedo, a 400 lb. of bombs, two Lewis machine guns, a radio set, a complete equipment of instruments and accessories, and a supply of fuel for four hours operation.

It has a wing speed of 107 m.p.h., and will climb from sea level in ten minutes to an altitude of 5,100 ft.



FIG. 2. THREE-QUARTER REAR VIEW OF THE NEW GLENN L. MARTIN TORPEDO PLANE

Purpose
The Martin Navy Torpedo plane is the forerunner of a new type of naval warfare. Its high speed, comparatively small dimensions and unusual maneuverability give it numerous advantages over the present-day torpedo boat destroyers.

This type of airplane is especially for operations with a fleet or directly from shore stations. Although it is not equipped with floats, it has, in addition to its specially designed landing chassis, emergency facilities long which are related by compressed air. Thus it is adapted for landing either on water or on land.

Operation With Fleet
In operating with a fleet, the plane fully loaded can take off from the deck of a warship or sea ship. Its cruising radius of 600 miles permits of several landings under circumstances,

Fig. 1. Diagram of the resistance curves.
Resistance relative to the maximum gliding resistance.
RELATIVE RESISTANCE TO MAXIMUM GLIDING RESISTANCE

1. Maximum gliding resistance
2. Maximum resistance
3. Maximum resistance

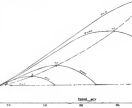


Fig. 2

On tracing the usual diagrams of the static and dynamic vertical thrusts and of the resistance of a seaplane (Fig. 1) if the gliding surface s has been lagged) selected the resistance changes according to a characteristic curve which after reaching a maximum decreases down to a minimum point, thereafter maintaining a constant course or nearly so. The maximum value in valid gliding resistance and corresponds to a gliding speed (v) which is the maximum at which the weight of the seaplane D is completely counteracted by the dynamic thrust of the hydro and aerial lift surfaces.

$$D = R_x + R_z + R_y + R_v$$

$$R_x = \frac{D}{\sqrt{1 + \frac{v^2}{v_0^2}}} \quad (3)$$

From this point

$$R_x = R_x + 1 + \frac{v^2}{v_0^2} \quad (4)$$

and as the gliding resistance to rise and a resistance to descend, the value of R remains practically constant. The sliding resistance is:

$$R_x = R_x + 1 + \frac{v^2}{v_0^2}$$

The foregoing equations (1), (2), (3), (4) lead to interesting theorems.

Applying the law of mechanical similarity, it is found that if two seaplanes are mechanically similar, the sliding surface, the critical and sliding speed, and all geometrical and aerodynamic elements are similar, according to the law established by the law of similarity.

This theorem is merely applied in practice, owing to the fact that, velocities were according to the \sqrt{N} and the power

$$\frac{NP}{D} \text{ according to a } 1/2, \text{ the ratio } \frac{NP}{D} \text{ varies according to } \sqrt{N} \text{ in } D$$

practical practice, however, N is a matter of passing from a known seaplane to another, keeping the same D (\sqrt{N} weight), that is, the same speed, but in this instance the mechanical law can only be applied to a very approximate manner. Let us consider the mechanical coefficients in the general case

$$\begin{aligned} \text{Weight strength } & \frac{P}{D} \\ \text{Speed } & v \\ \text{Power } & N \\ \text{Volume } & V \end{aligned}$$

Surface $s = 1/3$
Displacement $s = 1/3$

Among the experiments must exist the following equations

$$p = k \quad \frac{N}{D} = m + p$$

$$\frac{N}{D} = p - 2m$$

This relation results because the surface multiplied by the square of the speed gives a power at :

$$\frac{N}{D} = p - 2m$$

In the case of mechanical similarity

$$p = 2 + k \quad m = \frac{1}{2} \quad n = \frac{7}{2}$$

and thus $n-k = p - 2m$ is satisfied. In the second case, $n-k$

stands, making that the speeds be the same or $n = D$, and that the weights be in ratio to the cubes, $n-k = 3$ it is not possible to satisfy the equation

$$\frac{N}{D} = p - 2m$$

We should select the following ratios

$$\begin{aligned} \text{Weight strength } & \frac{P}{D} \\ \text{Speed } & v \\ \text{Power } & N \\ \text{Volume } & V \\ \text{Surface } & s \\ \text{Length } & l \end{aligned}$$

and thus can only be done in an approximate manner, by assuming the length of the float as constant.

In this instance no could say

If two seaplanes have equal speed, the gliding surface are to each other approximately as the ratio of the weights and of the surface apparatus

Mathematical example.—In the foregoing expressions k, N, D, V, l , let us give to D and to the coefficients the several values resulting in a practical case

$$\frac{P}{D} = 10 \text{ (ton } (m^2))$$

$$D = 10 \text{ (ton } (m^2))$$

$$D = 10 \text{ (ton } (m^2))$$

COMPARATIVE TABLE OF SEAPLANE FLIGHT PERFORMANCE

GLIDING RESISTANCE	CRITICAL SPEED	MAXIMUM RESISTANCE	SLIDING SPEED	SLIDING RESISTANCE
R_x (sq. m.)	V (m./sec.)	R_x (kg.)	V (m./sec.)	R_x (kg.)
0	20.50	6200	40	1000
0.1	24.50	6000	35.0	1000
0.2	16.00	2000	22	1435
1	17.20	3000	15.0	1280
3	9.00	1000	10.0	1380
6	8.70	1300	8	1245
7.5	7.70	1320	6.6	1345
10	7.30	1400	6.7	1345
20	6.00	1700	3.9	1335
30	6.00	1700	0	0.20

$$k = 20 \text{ kg/ sq. m/ sec.}$$

$$k_0 = 40 \text{ kg/ sq. m/ sec.}$$

$$k_0 = 20 \text{ kg/ sq. m/ sec.}$$

$$R_x = 1$$

$$R_y = 0$$

$$V_0 = 40 \text{ m/ sec. flying speed}$$

The coefficients are:

$$a = 4$$

$$b = 0.001$$

$$c = 1$$

$$d = 3.8$$

$$e = 0.041$$

The expressions (1), (2), (3) and (4) become

$$R_x = \frac{1000 + 5400 v^2 + 21000 v^4 + 4000}{(1000 + 20 v^2)} \times 1000$$

$$v = \sqrt{\frac{4 + 10}{100 + 20}} \times 1000$$

$$R_x = (1 + 4v) \times 1000$$

$$V = \sqrt{\frac{10000}{5 + 10 v}}$$

By giving to v increasing values, we now calculate the corresponding values of V and R_x , of V and R_x (see table) and embody them in curve (Fig. 2)

With the general formula, we calculate the resistances for the same values of v

$$R_x = (4 - 0.001 \times v^2) \times 1000 + (10 - 0.001 \times v^2) \times 1000$$

From the examining of the R_x and the V curves we deduce that:

In a seaplane of a given weight if the gliding surface varies, the maximum resistance R_x also varies, and precisely, with the increasing of the gliding surface, the maximum resistance decreases until it reaches a minimum which is the best value of the gliding surface

This minimum value of the maximum resistance presents interesting characteristics because it sets a limit for the surface, beyond which it is useless to increase the extension

In the case in question this value is 4.0 sq. m. and it may be found analytically or by means of the diagram, observing that the sliding resistance of a gliding surface of 4 sq. m. equals the maximum resistance

$$\frac{10000}{(1 + 4v)} = \frac{5400 v^2 + 5400 v^4 + 21000 v^2 + 4000}{(1000 + 20 v^2)}$$

from which equation we have v .

By letting v increase further, the value of the maximum resistance becomes a theoretical quantity, as indicated, reaching the critical speed, the vertical dynamic thrust equals the weight, that is, the sliding speed becomes less than the critical speed.

Regarding these values of the gliding surface, the resistance to the water is maximum but no edge corresponding to the sliding surface

The curve of R_x and V , beginning from the maximum value, increases and becomes asymptotic for a value of the speed v corresponding to $v = \infty$ (see table), this part of the curve is purely theoretical, to continue it would be necessary to have the complete loop of all the gliding surfaces considered, over beyond the sliding speed

It has been pointed out that it is not advisable to exceed the value of the best gliding surface, but if we study the curve of Fig. 2, it appears that the gliding surface may not have exactly the best value, for, without increasing the surface could be increased considerably without causing the maximum resistance and the critical speed to increase proportionately

For instance (see table) by reducing the sliding surface from 4 sq. m. to 3.0 sq. m., the R_x increases from 1250 kg. to 1435 kg. (only 30 kg.) and the critical speed from 6.50 m./sec. to 6.60 m./sec. If the plane is a slow one, it is not advisable to limit to an appreciable degree the sliding surface, but, in the case of a fast machine, with a considerable gliding speed, v , it is not possible to adapt large gliding surfaces

What has been said concerning floats with a separate gliding surface refers also to the gliding bottom floats, with the exception that the coefficients k, k_0 and k_1 are different and cannot be considered surface

If this study has shown that the required gliding surface can be calculated with satisfactory precision, thereby eliminating the useless overloading of the dimensions, the ratio of the surface to the weight constitutes a serious obstacle to the increasing of the size of the plane, as the weight of the floats increases too more rapidly than that of the plane.

Large seaplanes, consequently, must have large seaplanes, require good and greater ingenuity of solution by the designer, but, due to structure weight and maintenance of the floats, the characteristics of the plane reach its history.

The Ricot Commercial Seaplane R-1

The Ricot Type R-1 commercial seaplane was built to the design of the H. Ricot brothers by the Istituto Aeronautico Italiano, at Naples, Italy. The machine is entirely for ground operation, which consists of two parallel floats of standard type, and for the landing of the passenger, who are accommodated in a cabin situated in the center section, with the tail fin with the upper plane.

The power plant consists of three 10-hp. Franklin model V-6 engines of 220 hp. each, two of which are mounted on the wing nacelles, while the third engine is fixed in the nose of the center nacelle. The wing propellers are



R-1 COMMERCIAL BIPLANE. R. E. L. FLYER

When the R-1 is used for the carrying of mail and freight, compartments are fitted for this purpose in the forward portion of the two hulls. The center hull then accommodates two pilot forward, the fuel and oil tanks in the middle, and a mechanic aft. When the machine is used as a passenger carrier, the center portion is fitted as cabin for ten passengers beside the regulation crew of three, and the fuel and oil tanks are mounted in the hulls.

The two hull systems have been adopted, with a view to affording a strong and rigid support to the tail planes. These consist of a non-flying stabilizer and a rear power elevator. The top of the stabilizer are mounted three triangular vertical bars and two balanced rudders.

Another object the two hull system means is to distribute the weight and stresses over the whole structure as evenly as possible, and to reduce the dead weight of the flying portion.

The two hulls are built of tough cedar and are divided into a number of watertight compartments fitted with inspection ports. They are braced to one another as well as to the main planes by means of tubular steel struts.

The upper plane is cantilevered in front elevation. The lower plane is parallel to the upper plane in the center section, while the outer portions are set at a slight dihedral. Ailerons are fitted to both upper and lower planes.

The ailerons, rudders and the elevator as well as the inspection struts and the framework of the wings are now attached to steel tubing.

Following are the specifications of the R-1 E. L. flyer —



THREE-QUARTER REAR VIEW OF THE R-1 E. L. COMMERCIAL BIPLANE

SPECIFICATION

Rear, upper and lower plane 30.0 ft. 0 in.
Overall length 40.0 ft. 10 in.
Maximum height 13.0 ft. 10 in.
Total wing area 1,320 sq. ft.
Weight empty 4,100 lb.
Useful load 4,700 lb.
Weight loaded 8,800 lb.
Total horsepower 100 hp.
Maximum horizontal speed 130-135 m.p.h.
Endurance 4 hr.
Safety factor of planes 4

Forest Products Laboratory Celebration

The Forest Products Laboratory was organized by the U. S. Forest Service in 1900 and formally opened in June, 1911. It is conducted in cooperation with the University of Wisconsin.

During the ten years of its existence the efforts of the laboratory have been devoted to the development of improved methods and processes for the better utilization of forest products of all kinds, and to the direct assistance of the industries concerned.

During the war development assistance was rendered the War and Navy Departments and various other branches of the Government in the solution of many important problems, particularly in connection with aircraft, gun stocks, artillery, vehicle, motor weapons, and the boxing and crating of arms and stores for overseas shipment. It was necessary, throughout this period, to maintain all work on the regular production program.

A good many men requested with the work of the laboratory have represented the thought that the laboratory and its service rendered by it should receive some mark of recognition or appreciation from the industries which it serves. In response to this thought, the departmental authorities have been discussed, and the General Committee organized to carry out the detailed arrangements.

The present plan calls for a two-day program, including addresses by men prominent in science, industry, and commerce, together with the laboratory's a banquet, and various other forms of instruction and entertainment. It is proposed to make a permanent record of the discussion in the form of a souvenir publication to contain all of the addresses and other relevant matter, including all the names of those who can permit a permanent record of their respective contributions to be made.

General Description. The Loughhead sport-biplane is a single-plane airplane designed to give a good landing at a minimum of expense. It includes an industrial adaptation from standard aircraft design, and has an excellent performance.

Every thought has been taken to make the plane a "one man job," and the result is that practically any small field of country road becomes an airfield to the owner of a Loughhead sport-biplane. The patented wing folding feature reduces the landing space to a minimum, and the wing is of good design in a suitable manner. The simplicity of the gear plant stimulates the crew for expert maintenance and brings the cost of operation down.

Winged Wing Control. In addition to the conventional controls, a lever is placed at the side of the seat which throws the lower wings into a vertical position through an arc of 90 degrees, thus placing them in a convenient position for landing alongside the body, and also providing an extremely effective air-brake which makes it possible to stop the plane with a turn 30 to 75 ft. of the point where the wheels first break the ground. At the same time the lift of the wings is

composing one complete layer of plywood as a unit. The three complete layers of plywood are successively applied in a mold which determines the shape of the body, binding cloth and outer cover material being applied between the layers. The three layers are then subjected to a uniform air pressure of 30 lb. per sq. in., which is maintained over the entire surface until the glue has set.

This process produces a plywood shell of a uniform thickness of $\frac{1}{16}$ in., which is extremely strong for its weight.

At all points of attachment of the landing gear, wings, struts, etc., the weights are evenly distributed over large areas through reinforcing blocks and plates.

Cruiser Wings. The upper wing is built in three sections. The first tank is located in the forward part of the center section, and the landing gear is located at the rear upon a separate it is to be moved when pilot is getting on or out of cockpit. It folds, but very rigid hinges hold it in place during a pit.

The fact that no ailerons are employed makes it possible to use the most efficient semi-cylindrical flaps for the wing tips on both the upper and lower planes. The trailing edge is



THE LOUGHEAD SPORT PLANE AT THE SAN FRANCISCO AERO SHOW

reduced nearly 50 per cent as that the plane has an incidence, even in a strong wind, to leave the ground after landing.

Strut Arrangement. The upper and lower wings are supported by a V strut, near the wing tips, which is rigidly bolted to the upper wing spars and fastened to the rear of the lower wing by a simple, but rigid pipe connection.

Lower Wing. The lower wing is similar in form to the upper, except that one deep spar serves to brace the wing in all directions. The spar is pivoted at the body, and at the lower end of the V strut, allowing the whole wing to move, and it is thus action which affords a very simple and efficient lateral control. The control point is just forward of the center of pressure of the wing, so that there is a very light strain on the lever mechanism which transmits the motion of the control stick to the wings.

This action of control eliminates all lost motion and friction found in the conventional cable and pulley system, and will hold as long as the plane, eliminating all cable replacements connected with conventional types.

Wings. There are only five wires on each side of the body—three drag, one landing, and one drift. This construction gives a trailing system which is simple, better over time than a single rail of an ordinary biplane, and at the same time retaining great strength. All are large Watrous cables, carefully strung and covered with rubber.

Fuselage Construction. The fuselage of the sport biplane is of the well-known monocoque type, consisting of a thin shell of plywood reinforced by numerous bulkheads, of perfect strength.

In the new process evolved by the Loughhead Aircraft Co., arrangements have been made to handle the many steps

square plywood, coated not except at points of attachment, and the trailing edge is of steel.

Strut Surface. The horizontal and vertical stabilizers are rigidly braced internally by lattice rods. The main bar of the elevators is a heavy channel steel member to which the control levers and wires are fastened inside the fuselage. The rubber is constructed in the same manner, and all control wires are made simply strong, so that no external wires are ever needed.

By removing the open-detectable aluminum tail-pipe all fastenings are readily accessible for inspection and adjustments.

Tail Unit. The tail unit is mounted in such a manner that there is no connection between the fuselage and the tail itself upon forward movement. This movement of the tail unit allows and makes a mounting that is absolutely dependable.

Landing Gear. The landing gear is of conventional type, but it has been simplified and lightened to make it more maneuverable with safety. Rubber shock absorbers are employed, and the main gear has a factor of safety of over 10 to 1.

Factor of Safety. A factor of safety of over 4 to 1 by actual wind load test has been maintained throughout the machine. This, coupled with the extremely light wing loading of only 5 lb. per sq. ft., insures sufficient structural strength to withstand the stress of any performance to which it can be subjected.

Finish. The fuselage is finished exteriorly, and the wings cross color. All wire, cables, bolts and metal parts are rust-proofed by a process developed by the Loughhead Aircraft Corp., which does not injure the materials and protects them thoroughly.

blade horns are not dangerous, because silk will not burn unless fed by heat or flame, and the silk only burns if the air is heated. I have tested parachute canopy (silk) until they were burned as much as ten or twelve times, and then broken them with a heavy load and high speed, without any detrimental effects at the particular location of the horns.

In a properly constructed parachute, the silk has a greater factor of safety than the reinforcements, and the silk does not burn where it is doubled or reinforced. The horns generally break in one from one to six square inches.

Preventing does not prevent and it burns although it helps a little by reducing the susceptibility of the silk to stains.

Colors do not prevent the high speed parachute although it is much less susceptible to fire's harm. The fine cotton wing cotton is just double the weight of a good bleaching silk and the same is made stronger in the filling and a parachute constructed of the wing cotton will hold about 75 per cent of the load that a similar silk parachute will hold.

The silk parachute allows a great deal of air to flow through it and thereby forms a shock absorber in itself, whereas the cotton parachute holds the part of the air and stops very abruptly. This action of both parachutes is much more pronounced at high speeds.

The rate of descent of a parachute with a given load is not controlled entirely by its area. The shape and porosity of the fabric have an important bearing on the rate of descent. For instance, a 31 1/2 ft. diameter silk parachute of 28 ft. diameter will descend at the same rate, with a given load, as a 2 ft. diameter silk chute of 34 ft. diameter.

A full formed parachute will drop about 15 per cent slower than a flat parachute. Forward is accomplished by reducing the area exposed towards the center or down edge, thereby giving it a form similar to the form when descended with the load suspended from the shock, or periphery of the chute. The flat chute allows much more air to flow around before such shock has been produced, a leakage of air, and is suffering with the shock vortex, which is a large factor in suspension and stability.

A full formed chute will not hold over the load that a flat chute will, varying a great deal with the porosity of the fabric. At speeds of 120 m.p.h. or more, a parachute opens to a wide open flat state in less than one second, and the flat chute will open to that position with very little strain on the outer portions. The full formed parachute will not open to a flat state, and the resultant stream, (very similar to the forces around the periphery of a beach crater,) are expanded

on the shock, and the fabric just cracks. A parachute can be about half formed, on the outer third of the periphery, and result in a slower rate of descent, without greatly impairing the high speed strength.

A parachute opens to a wide state in less time with a heavy load than with a light load. This is more pronounced with small leakage fabric, and at high speeds. With the light load the first half of the opening reduces the speed to a great extent, therefore the last half of the opening is operating at slow speed. The speed of the heavy load is not affected as much, therefore, the last half of the opening is at high speed.

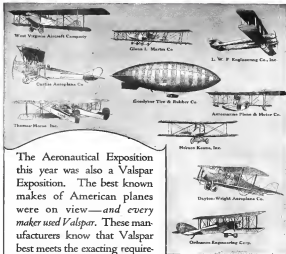
Parachutes will hold a given weight at a higher speed on the horizontal than on the vertical drop, or steep dive. On the horizontal the parachute has only the momentum to stop, and on the dive it has the momentum plus gravity. This is not very important except with heavy weight.

Long stream lines give a slower rate of descent, and less oscillation in moderate air, but a greater oscillation in rough air. They give a larger swing, and maintain the oscillation over a longer period.

Short stream lines pull the chute in to a smaller diameter, and increase rate of descent, and swing quickly in choppy air, but also lose the swing quicker. Any parachute will oscillate in rough air, but it is not dangerous and can usually be stopped by pulling on stream lines, on the back of the wing.

A cord on the top of a parachute catches a vortex of air in a silk chute is hard to pull, and therefore results in failure. A parachute is fixed a cord will often swing in rough air until it splits air, when that side of the chute will slide off the stream of air making air, and partially collapse, but this type is very dangerous if over the ground.

I also tested what is known as a flexible vent, which has been successfully successful at reducing a parachute to hold heavy weight at high speeds, when properly constructed. I do not advise its use because it is dangerous under certain conditions, especially when poorly constructed. It is a large vent, 3 to 4 ft. in dia., in the top of parachute, with a slowness of fabric sewed to it, with several cord bristles attached to the top edge of the slowness, with rubbers attached so that normally the top edge is held in the center of the vent thereby closing it. When the parachute opens at high speed or with heavy weight, the inside air pressure causes the rubbers and the slowness to be forced up, and open, allows air to escape and reduce the pressure. When the speed reduces, the rubbers close the vent again to normal conditions.



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These plans are worthy of the confidence and support of all classes of Citizens, City, County, State and National Officials.

The quality of the personnel is a guarantee that the enterprise will be directed by men qualified by previous experience to manage successfully any undertaking they are identified with.

"The Motor That Made the Great Possible"

These Advantages Helped Make a Better Airplane Engine for You

THE Wright-Hispano Aeronautical Engine is the American development of the famous French motor which was designed in 1914 to incorporate advantages not possessed by other engines at that time.

Further American development has brought about many important changes in the original design which has "carried on" still further the competitive advantages that have always been a characteristic of this great engine.

It is our purpose to make clear to the plane builder and owner in these pages the advantages possessed by the Wright-Hispano Engine in dependability, compactness, streamlining, flexibility, accessibility, weight-to-horse power and reliability.

In no other way can this Organization so well acknowledge its obligation to the manufacturer and the flyer and its firm purpose to remain pre-eminent in the aircraft motor field.

They are available for immediate delivery the H. P. (Model K) Engine in complete plane manufacturers and responsible sources.

WRIGHT
Aeronautical Corporation
New Brunswick, N. J.

Member Manufacturers
Aircraft Association



Leaves H. P. Engine
V-8's with
40-hp. Hispano
Aeronautical Engine

WRIGHT-HISPANO
AERONAUTICAL ENGINE



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Goodyear's Pony Blimp—A Training Craft

EVEN when considered solely as a training ship, the value of the Goodyear Pony Blimp is inestimable.

Take for example its use by an Aero Club; consider the training given to fifty or perhaps a hundred men.

Many will become skilled in the theory and practice of airship design, in piloting, even in meteorology.

Without prohibitive expense, men can be trained as active, competent pilots who otherwise would remain passively interested.

An essential set of these men is thus provided for the fleets of airships to be engaged in commerce and in the nation's work.

Built of a quality that protects our good name, the Goodyear Pony Blimp will serve well as a producer of airship men, while used in survey work or by Aero Clubs.

*Balloons of Any Size and Every Type
Everything in Rubber for the Airplane*

GOOD YEAR

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